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BEFORE THE BOARD OF PATENT APPEALS AND INTERFERENCES

Application Number: 10/763,353
Filing Date: January 23, 2004
Appellant(s): HOFFMAN ET AL.

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EXAMINER'S ANSWER

This is in response to the appeal brief filed January 27, 2009 appealing from the Office action mailed June 2, 2008.

(1) Real Party in Interest

A statement identifying by name the real party in interest is contained in the brief.

(2) Related Appeals and Interferences

The examiner is not aware of any related appeals, interferences, or judicial proceedings which will directly affect or be directly affected by or have a bearing on the Board's decision in the pending appeal.

(3) Status of Claims

The statement of the status of claims contained in the brief is correct.

(5) Summary of Claimed Subject Matter

The summary of claimed subject matter contained in the brief is correct. The examiner adds that the Amendment filed with the Notice of Appeal has NOT been entered, which is also reflected in the absence of the amendment in the Claims Appendix, the latter being identical to those rejected in the appealed office action mailed 6/2/08.

(6) Grounds of Rejection to be Reviewed on Appeal

The appellant's statement of the grounds of rejection to be reviewed on appeal is correct.

(7) Claims Appendix

The copy of the appealed claims contained in the Appendix to the brief is correct.

(8) Evidence Relied Upon

2004/0127038 A1	CARCIA ET AL.	7-2004
4,521,698	TAYLOR	6-1985

6,100,558	KRIVOKAPIC ET AL.	8-2000
6,674,495 B1	HONG ET AL.	1-2004
2004/0169210 A1	HORNIK ET AL.	9-2004
5,744,864	CILLESSEN ET AL.	4-1998
6,184,946 B1	ANDO ET AL.	2-2001
2003/0185266 A1	HENRICHS	10-2003

- Young et al, "Growth and characterization of radio frequency magnetron sputter-deposited zinc stannate, Zn_2SnO_4, thin films", Journal of Applied Physics, Volume 92, Number 1 (July 1, 2002), pages 310-319, especially section V.
- Fang et al, "Hydrothermal preparation and characterization of Zn_2SnO_4 particles", Materials research Bulletin, 36 (2001), pp. 1391-1397, in particular p. 1396 ("4. Conclusion"). See PTO-892 and Interview Summary herewith included confirming appellants have been in possession of Fang et al, despite its initial inadvertent omission from PTO-892, as examiner had faxed a copy to appellants.

(9) Grounds of Rejection

The following ground(s) of rejection are applicable to the appealed claims:

Said ground(s) are an exact copy of the ground(s) as set forth in the appealed Office action (mailed June 2, 2008), as follows:

BEGINNING OF GROUNDS OF REJECTION:

Claim Rejections - 35 USC § 102

A person shall be entitled to a patent unless –

(e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

1. ***Claims 4, 6-9, 11, 26, 31-36, 48 and 50, 54, 55, 60*** are rejected under 35 U.S.C. 102(e) as being anticipated by Carcia et al (US 2004/0127038 A1) (cited previously; IDS).

Carcia et al teach a semiconductor device (thin film transistor; see title), comprising: a source electrode ("Source", Figure 3, also: inherent in thin film transistor); a drain electrode ("Drain", Figure 3, equally inherent on thin film transistor), a channel coupled to the source and drain electrode (zinc oxide comprising semiconductor layer; see Figure 3 and [0042]; said channel also is inherent in any thin film transistor) and comprised of a ternary compound containing zinc, tin and oxygen (see [0010]), where at least a portion of the channel is formed from a zinc-tin oxide compound having the stoichiometric formula Zn_2SnO_4 (namely: one of said "combinations", especially the combination $2ZnO + SnO_2 \rightarrow Zn_2SnO_4$); and a gate electrode ("Gate" in Figure 3; equally inherent in any thin film transistor) configured to permit application of an electric field to the channel (which is the very function of a gate) (Examiner note: only very few elementary oxides are listed of which combinations are disclosed to be included as well).

On claim 6 and 31: the limitation "substantially amorphous" is met by Carcia et al, because inherently sputtering creates substantially amorphous forms of zinc

oxide based oxides, as witnessed for example by Henrichs (US 2003/0185266 A1) ([0046], not cited here other than for establishment of fact; and cited previously).

On claim 7: one or more of the source, drain and gate electrodes are fabricated so as to be at least partially transparent (all of gate, drain and source electrodes are made of transparent zinc oxide; see Example 7, [0053]).

On claims 8-9: the limitations of claims 8 and 9 are met by virtue of the finite dissociation constant of Zn_2SnO_4. For the finiteness of said dissociation constant the examiner has previously taken official notice. Accordingly, the finite dissociation constant of Zn2SnO4 is considered Prior Art admitted by Applicant (cf. MPEP 2144.03[R-1]).

On claim 11: The limitation "is adapted to be deposited using an RF sputtering process", is only of patentable weight in as much as the method steps distinguish the final structure, and to the extent not impacting final structure are taken to be product-by-process limitations and non-limiting. A product by process claim is directed to the product per se, no matter how they are actually made. See In re Fessman, 180 USPQ 324, 326 (CCPA 1974); In re Marosi et al, 218 USPQ 289, 292 (Fed. Cir. 1983), and In re Thorpe, 227 USPQ 964, 966 (Fed. Cir. 1985), all of which make clear that it is the patentability of the final structure of the product "gleaned" from the process steps that must be determined in a "product-by-process" claim, and not the patentability of the process. See also MPEP 2113. Moreover, an old or obvious product produced by a new method is not a patentable product, whether claimed in "product by process" claims or not.

In the underlying case it is therefore only parenthetically mentioned that indeed the channel of the prior art is adapted to be deposited using RF sputtering ([0010] and [0047]).

On claim 26: the examiner takes official notice that the limitation defined by this claim is inherently met, by any thin film transistor by definition of its gate. The official notice has not been traversed, and accordingly the subject matter of it is considered Prior Art admitted by Applicant (cf. MPEP 2144.03[R-1]).

On claim 32: source, drain and gate electrodes are fabricated so as to be at least partially transparent (see abstract).

On claims 33-34: the limitations of claims 8 and 9, and of claims 33 and 34 are met by virtue of the finite dissociation constant of a ternary zinc-tin-oxide compound. For the finiteness of said dissociation constant the examiner had previously taken official notice; in support examiner refers to Fang et al, Material research Bulletin, Volume 36 (2001), 1391-1397, in which a tendency of Zn2SnO4 towards ZnO at some temperature is disclosed (see page 1396, "4. Conclusion").

On claim 35: one or more of the source, drain and gate electrodes are fabricated so as to be at least partially transparent (all of gate, drain and source electrodes are made of transparent zinc oxide; see Example 7, [0053]).

On claim 36: The limitation "is adapted to be deposited using an RF sputtering process", is only of patentable weight in as much as the method steps distinguish the final structure, and to the extent not impacting final structure are taken to be product-by-process limitations and non-limiting. A product by process claim is directed to the

product per se, no matter how they are actually made. See In re Fessman, 180 USPQ 324, 326 (CCPA 1974); In re Marosi et al, 218 USPQ 289, 292 (Fed. Cir. 1983), and In re Thorpe, 227 USPQ 964, 966 (Fed. Cir. 1985), all of which make clear that it is the patentability of the final structure of the product “gleaned” from the process steps that must be determined in a “product-by-process” claim, and not the patentability of the process. See also MPEP 2113. Moreover, an old or obvious product produced by a new method is not a patentable product, whether claimed in “product by process” claims or not. In the underlying case it is therefore only parenthetically mentioned that indeed the channel of the prior art is adapted to be deposited using RF sputtering ([0010] and [0047]).

On claim 48: Carcia et al teach a display (their claim 16) comprising: a plurality of display elements configured to being capable to operate collectively to display images, wherein each of the display elements includes a semiconductor device configured to control light emitted by the display element (namely: the transparent oxide semiconductor transistors; see their claim 16), the semiconductor device including: a source electrode (“Source”, Figure 3, also: inherent in thin film transistor); a drain electrode (“Drain”, Figure 3, equally inherent on thin film transistor), a channel coupled to the source and drain electrode (zinc oxide comprising semiconductor layer; see Figure 3 and [0042]; said channel also is inherent in any thin film transistor) and comprised of a ternary compound containing zinc, tin and oxygen (see [0010]), where at least a portion of the channel is formed from a zinc-tin oxide compound having the stoichiometric formula Zn2SnO4 (namely: one of said “combinations”, especially the

combination $2ZnO + SnO_2 \rightarrow Zn_2SnO_4$); and a gate electrode ("Gate" in Figure 3; equally inherent in any thin film transistor) configured to permit application of an electric field to the channel (which is the very function of a gate).

On claim 50: Carcia et al teach a semiconductor device (TFT), comprising:

a source electrode, a drain electrode, a channel coupled to the source electrode and the drain electrode and comprised of a ternary compound containing zinc, tin and oxygen ([0010]); and a gate electrode by definition configured to permit application of an electric field to the channel (N.B.: only its capability to do so is patentable, and said capability is inherent in "gate" of a field effect transistor, hence also of "gate" of a thin film transistor.

On claim 54: one or more of the source, drain and gate electrodes are fabricated so as to be at least partially transparent (all of gate, drain and source electrodes are made of transparent zinc oxide; see Example 7, [0053]).

On claim 55: the gate electrode in Carcia et al is physically separated from the channel by a dielectric material (SiO_2 in Figure 3, [0046]).

On claim 60: Carcia et al teach a thin film transistor (see "Summary of the Invention"), inherently comprising a gate electrode (see also Figure 3, "VgGate" indicating voltage to gate electrode underneath an n+ gate region), a channel layer (see also Figure 3, the region between source and drain abutting both) and dielectric material disposed between and separating the gate electrode and channel layer (see Figure 3, the region separating source, channel and drain from gate region and gate electrode); first and second electrodes spaced from each other and disposed adjacent the channel

layer on a side opposite the dielectric material, such that the channel layer is disposed between and electrically separates the first and second electrodes. At least a portion of the channel is formed from a zinc-tin oxide compound having the stoichiometric formula Zn2SnO4 (namely: one of said "combinations", especially the combination $2ZnO + SnO_2 \rightarrow Zn_2SnO_4$); and a gate electrode ("Gate" in Figure 3; equally inherent in any thin film transistor) configured to permit application of an electric field to the channel (which is the very function of a gate) (Examiner note: only very few elementary oxides are listed of which combinations are disclosed to be included as well).

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

2. ***Claim 19*** is rejected under 35 U.S.C. 103(a) as being unpatentable over Carcia et al (US 2004/0127038 A1) (cited previously, and IDS) in view of Taylor (4,521,698) (cited previously).

On claim 19: Carcia et al teach a three-port device (source, drain and gate being the three ports), comprising: a source electrode ("Source"; Figure 3); a drain electrode ("Drain"; cf. Figure 3); a gate electrode (""Gate"; Figure 3); furthermore, in reference to the claim limitation "means for providing a channel configured to permit movement of electric charges there-through between the source electrode and the gate electrode, intended use and other types of functional language must result in a structural

difference between the claimed invention and the prior art in order to patentably distinguish the claimed invention from the prior art. If the prior art structure is capable of performing the intended use, then it meets the claim. In re Casey, 152 USPQ 235 (CCPA 1967); In re Otto , 136 USPQ 458, 459 (CCPA 1963).

In the underlying case, it is thus only parenthetically mentioned that indeed the prior art by Carcia et al teaches a means for providing channel disposed between the source electrode and the drain electrode (said means being a semiconducting oxide layer comprising zinc separating source and channel with a gate electrode sufficiently nearby to produce a channel when given a voltage that either accumulates, depletes or inverts the interface between the semiconducting oxide layer and a dielectric layer separating gate from semiconductor oxide layer; furthermore, channel is inherent in the thin film transistor by Carcia et al and is implied by the existence of a gate near a channel forming substance, as the ZnO area in Figure 3), inherently permitting movement of electric charge there-through between source and drain in response to a voltage applied at the gate electrode, the means for providing a channel formed at least in part from a ternary compound containing zinc, tin and oxygen, where the means for providing a channel includes means for providing a semiconductor formed from a zinc-tin oxide compound having the stoichiometry Zn_2SnO_4.

Also, the limitation "means for providing a semiconductor" (second line from below) constitutes a product-by-process limitation, because, while said channel comes about through a method of use (application of voltage to gate), the "means

for providing a semiconductor is a limitation on how to make said semiconductor. The limitation is only of patentable weight in as much as the method steps distinguish the final structure, and to the extent not impacting final structure are taken to be product-by-process limitations and non-limiting. A product by process claim is directed to the product per se, no matter how they are actually made. See In re Fessman, 180 USPQ 324, 326 (CCPA 1974); In re Marosi et al, 218 USPQ 289, 292 (Fed. Cir. 1983), and In re Thorpe, 227 USPQ 964, 966 (Fed. Cir. 1985), all of which make clear that it is the patentability of the final structure of the product "gleaned" from the process steps that must be determined in a "product-by-process" claim, and not the patentability of the process. See also MPEP 2113. Moreover, an old or obvious product produced by a new method is not a patentable product, whether claimed in "product by process" claims or not.

Carcia et al do not necessarily teach the limitation on movement of electric charge between source and gate electrode in response to voltage (lines 6-8). *However, it would have been obvious to include said limitation in view of Taylor, who, in a patent on insulated gate field effect transistors, namely MOSFETs*, hence related art, teach the use thereof wherein gate and drain are conductively connected so as to avoid hot electron effects (title, abstract, Figure 3; in particular transistor 224; and columns 1-3).

Motivation to include the teaching by Taylor at least derives from the generic undesirability of hot electron effects, i.e., effect whereby the acceleration of electrons due to the voltage head between source and drain leads to electron-electron

collisions upon the impact on the drain region of accelerated electrons from the channel, resulting in the excitation of valence electrons into the conduction band, i.e., to electron-hole pair production, resulting, due to the relatively large effective mass of the holes, in unwanted further bias of the semiconductor region near the channel.

3. ***Claim 12*** is rejected under 35 U.S.C. 103(a) as being unpatentable over Carcia et al as applied to claim 50, in view of Hong et al (6,674,495 B1) (cited previously).

As detailed above, Carcia et al anticipate claim 50. Carcia et al do not necessarily teach the further limitation that the source and drain electrodes are formed from an indium-tin oxide material. However, it would have been obvious to include this further limitation in view of Hong et al, who, in a patent on a thin film transistor array panel for display, hence analogous art (see title and abstract), teach the source and drain electrodes to be ITO (i.e., indium-tin oxide) electrodes (see column 20, lines 25-37, and e.g., Figures 1 and 23) in a patent in which ITO and zinc oxide are both respectively cited for conductivity and transparency, two important advantages for electrode material in a display (see, e.g., columns 9 and 20). Inherently, source and drain electrodes in any thin film transistor, in fact in any field effect transistor, are separate from one another. Applicant is reminded in this regard that it has been held that mere selection of known materials generally understood to be suitable to make a device, the selection of the particular material being on the basis of suitability for the intended use, would be entirely obvious. In re Leshin 125 USPQ 416. Furthermore, the limitations "formed from"

and “patterned” constitute product-by-process limitations and are only of patentable weight in as much as the method steps distinguish the final structure, and to the extent not impacting final structure are taken to be product-by-process limitations and non-limiting. A product by process claim is directed to the product per se, no matter how they are actually made. See In re Fessman, 180 USPQ 324, 326 (CCPA 1974); In re Marosi et al, 218 USPQ 289, 292 (Fed. Cir. 1983), and In re Thorpe, 227 USPQ 964, 966 (Fed. Cir. 1985), all of which make clear that it is the patentability of the final structure of the product “gleaned” from the process steps that must be determined in a “product-by-process” claim, and not the patentability of the process. See also MPEP 2113. Moreover, an old or obvious product produced by a new method is not a patentable product, whether claimed in “product by process” claims or not.

4. ***Claims 15 and 39*** are rejected under 35 U.S.C. 103(a) as being unpatentable over Carcia et al and Krivokapic et al as applied to claims 14 and 38, respectively, above, and further in view of Hornik et al (US 2004/0169210 A1) (cited previously).

As detailed above, claims 14 and 38 are unpatentable over Carcia et al in view of Krivokapic et al.

Neither Carcia et al nor Krivokapic et al necessarily teach the further limitation defined by claims 15 or 39, respectively.

However, it would have been obvious to include said further limitation in view of *Hornik et al,* who, in a patent on barrier material against the diffusion of hydrogen into a high dielectric constant layer such as PZT during passivation of gate oxide, teaches to

protect said layer of PZT with a pair of Al_2O_3 layers with a TiO_2 layer in between (see [0006] and [0024]). *Because PZT is also included in the teaching by Krivokapic et al as one of the gate oxide materials, it would have been obvious* to include the teaching on hydrogen diffusion barrier structure against deterioration of PZT also in the gate oxide by Krivokapic et al. To protect the PZT layer optimally it would furthermore have been obvious to provide the $Al_2O_3/TiO_2/Al_2O_3$ layer on both sides of the PZT layer, thus meeting the claim limitation. *Motivation* to include the teaching by Homik et al derives immediately from the increased integrity resulting from the protection of the PZT against a lowering of its dielectric constant due to hydrogen diffusion.

5. ***Claim 64*** is rejected under 35 U.S.C. 103(a) as being unpatentable over Carcia et al in view of Cillessen et al (5,744,864) (previously cited and made of record by applicant in IDS) and Ando et al (6,184,946 B1) (cited previously).

Carcia et al teach a semiconductor device including a source electrode, a drain electrode, a channel coupled to the source electrode and the drain electrode; and a gate electrode configured to permit application of an electric field to the channel, all of the above inherent in the thin film transistor (TFT) by Carcia, and disclosed in Figure 3, Examples 1-7. Although the provisional application by Carcia et al does not disclose the limitation that the channel is formed of zinc-tin-oxide, it would have been obvious to include said limitation in view of Cillessen et al, who, in a patent on a semiconductor device with source, drain and insulated gate (see Figure 4 and col. 4, l. 27+), hence art analogous to Carcia et al, teach that the channel is formed of covalent oxide of a non-transition metal including ZnO , or SnO_2 or mixtures or compounds thereof (col. 5, l. 30-

50). *The claim would have been obvious because* one of ordinary skill has good reason to pursue the known options within his or her technical grasp; if this leads to the anticipated success, it is likely the product not of innovation but of ordinary skill and common sense.

Carcia et al do not necessarily teach the limitation that said semiconductor device is included in a display comprising a plurality of display elements configured to operate collectively to display images, where each of the display elements includes a semiconductor device configured to control light emitted by the display element. *However, it would have been obvious to include said further limitation in view of Ando et al, who*, in a patent on thin film transistor based applications to display technology (title and abstract), hence analogous art, teach the application of thin film transistors (TFTs) (col. 4, l. 3-25), in particular as switching elements (abstract) used for switching in a method for controlling an active matrix display (title, abstract), wherein the TFT selectively controls activation and deactivation of a pixel of the active matrix display by selectively controlling the gate voltage (cols. 1-col. 2, l. 5: that is how thin film transistor function). *Motivation* to include the teaching by Ando et al in the invention by Carcia et al derives from the obvious advantage of applying a transparent and high mobility TFT such as taught by Carcia et al to said active matrix display because little light is lost by absorption by the thin film transistor (said semiconductor layer being transparent to light; Figure 7 and discussion) while the device speed is still high as witnessed by the excellent current-voltage characteristics (i.e., mobility) (see Figures 4-9).

6. ***Claims 4, 7-9, 12, 19, 26, 32-35, 37, 48, 50, 54, 55, 60 and 64*** are rejected under 35 U.S.C. 103(a) as being unpatentable over Cillessen et al (5,744,864).

On claim 4: Cillessen et al teach a thin film transistor (see col. 1, l. 13) comprising (inherently) a source electrode and a drain electrode (2 and 3 or 3 and 2) (col. 4, l. 26-58 and abstract); a channel 4 (col. 4, l. 35 and abstract) coupled to the source and drain electrodes and comprised of a covalent oxide of a non-transition metal (col. 4, l. 34-43), and a gate electrode 5 (col. 4, l. 36 and abstract) configured to permit application of an electric field to the channel.

Cillessen et al also teach said covalent oxide of a non-transition metal in terms of examples of a list of eight such oxides, - including both ZnO and SnO_2, and mixtures or compounds formed from said oxides; and preferably a covalent oxide from the group Sn, Zn, In. The formation of a zinc-tin-oxide compound having the stoichiometry Zn_2SnO_4, although not explicitly recited by Cillessen et al, is indeed a simple compound formed from ZnO and SnO2, namely: ZnO + SnO_2. The claim would have been obvious because one of ordinary skill has good reason to pursue the known options within his or her technical grasp. If this leads to the anticipated success, it is likely the product not of innovation but of ordinary skill and common sense.

On claim 19: Cillessen et al teach a three-port semiconductor device (thin film transistor; see col. 1, l. 5-18), comprising (inherently) a source electrode and a drain electrode, and a gate electrode (2, 3 and 5 or 3, 2 and 5: see abstract col. 4, l. 27+; Figure 4); and means for providing a channel 4 (col. 4, l. 35 and abstract) (Examiner note: said means for providing a channel in light of the specification, and conform 35

U.S.C. 112, sixth paragraph, identified as element 18 in said Specification, which is a channel region, within which by action of the gate a (narrow) channel is formed in the ON state), the means for providing a channel formed at least in part from a covalent oxide of a non-transition metal (col. 4, l. 34-43), and a gate electrode 5 (col. 4, l. 36 and abstract) configured to permit application of an electric field to the channel.

Cillessen et al also teach said covalent oxide of a non-transition metal in terms of examples of a list of eight such oxides, - including both ZnO and SnO_2, and mixtures or compounds formed from said oxides, and preferably a covalent oxide from the group Sn, Zn, In (col. 5, l. 50-60). The formation of a zinc-tin-oxide compound having the stoichiometry Zn_2SnO_4 is indeed a simple compound formed from ZnO and SnO2, namely: ZnO + SnO_2. The claim would have been obvious because one of ordinary skill has good reason to pursue the known options within his or her technical grasp. If this leads to the anticipated success, it is likely the product not of innovation but of ordinary skill and common sense.

On claim 48: Cillessen et al teach a display (col. 2, l. 63 – col. 3, l. 24), comprising a plurality of display elements (loc. cit.) configured to operate collectively to display images (col. 3, l. 25-40), where each of the display elements includes a semiconductor device configured to control light emitted by the display element (being a switching element (see col. 1, l. 5+ and col. 2, l. 63 – col. 3, l. 40), the semiconductor device including: a source electrode and a drain electrode (2 and 3 or 3 and 2, resp.) (col. 4, l. 27-58 and abstract); a channel coupled to the source electrode and the drain electrode and comprised of a covalent oxide of a non-transition metal (col. 4, l. 34-43),

and a gate electrode 5 (col. 4, l. 36 and abstract) configured to permit application of an electric field to the channel (see Figure 4).

Cillessen et al also teach said covalent oxide of a non-transition metal in terms of examples of a list of eight such oxides, - including both ZnO and SnO_2, and mixtures or compounds formed from said oxides, and preferable a covalent oxide from the group Sn, Zn, In (col. 5, l. 50-60). The formation of a zinc-tin-oxide compound having the stoichiometry Zn_2SnO_4, although not explicitly taught, is indeed a simple compound formed from ZnO and SnO2, namely: ZnO + SnO_2. The claim would have been obvious because one of ordinary skill has good reason to pursue the known options within his or her technical grasp. If this leads to the anticipated success, it is likely the product not of innovation but of ordinary skill and common sense.

On claim 50: Cillessen et al teach a semiconductor device (title), comprising: a source electrode and a drain electrode (2 and 3, or 3 and 2; see abstract and col. 4, l. 27-58); a channel 4 (abstract and col. 4, l. 27-58) coupled to the source electrode and the drain electrode and comprised of a covalent oxide of a non-transition metal (col. 4, l. 34-43); an a gate electrode 5 (col. 4, l. 27+ and abstract) configured to permit application of an electric field to the channel (see Figure 4).

Cillessen et al also teach said covalent oxide of a non-transition metal in terms of examples of a list of eight such oxides, - including both ZnO and SnO_2, and mixtures or compounds formed from said oxides; and preferably a covalent oxide of the group Sn, Zn, In (col. 5, l. 50-60). The formation of a ternary zinc-tin-oxide compound, although not explicitly recited by Cillessen et al, is indeed a simple compound formed from ZnO

and SnO_2. The claim would have been obvious because one of ordinary skill has good reason to pursue the known options within his or her technical grasp. If this leads to the anticipated success, it is likely the product not of innovation but of ordinary skill and common sense.

On claim 60: Cillessen et al teach a thin-film transistor (col. 1, l. 5-12: see especially the reference to Japanese Patent Application 60-198861 as defining the kind of device to which the invention relates, which is a thin-film transistor), comprising: a gate electrode 5 (abstract and col. 4, l. 27-58); a channel layer 4 formed of a covalent oxide of a non-transition metal (col. 5, l. 30-50), preferably an oxide from Zn, Sn, In; a dielectric material 6 disposed between and separating the gate electrode and the channel layer (Figure 4, abstract and col. 4, l. 27-58); and first and second electrodes 2 and 3 (abstract and col. 4, l. 27-58) spaced from each other and disposed adjacent the channel layer on a side of the channel layer 4 opposite the dielectric material 6 such that the channel layer is disposed between and electrically separates said first and second electrodes (Figure 4 and abstract).

Cillessen et al also teach said covalent oxide of a non-transition metal in terms of examples of a list of eight such oxides, - including both ZnO and SnO_2, and mixtures or compounds formed from said oxides; and preferably a covalent oxide from the group Sn, Zn, In. The formation of a ternary zinc-tin-oxide material, including the compound Zn_2SnO_4 is indeed obtainable through rf magnetron sputtering with reasonable expectation of success, as either mixture or compound from ZnO and SnO_2. All ternary compounds that are combinations in the aforementioned manner are easily tested on

mobility and hence their suitability as channel material. Furthermore, ternary compounds are the simplest of compounds that are combinations of any binary compounds. The claim would have been obvious because one of ordinary skill has good reason to pursue the known options within his or her technical grasp. If this leads to the anticipated success, it is likely the product not of innovation but of ordinary skill and common sense.

On claim 64: Cillessen et al teach a display (col. 2, l. 63 – col. 3, l. 24), comprising: a plurality of display elements configured to operate collectively to display images (loc.cit and col. 3, l. 25-40), where each of the display elements includes a semiconductor device (their thin film transistor (col. 1, l. 5-12) as 'switching element'; see col. 3, l. 6) configured to control light emitted by the display element, the semiconductor element including: a source electrode and a drain electrode (2 and 3 or 3 and 2; abstract and col. 4, l. 27-58; see Figure 4) a channel coupled to the source electrode and the drain electrode and comprised of a covalent oxide of a non-transition metal (col. 5, l. 30-50); and a gate electrode 5 (abstract and col. 4, l. 27-58) configured to permit application of an electric field to the channel.

Cillessen et al also teach said covalent oxide of a non-transition metal in terms of examples of a list of eight such oxides, - including both ZnO and SnO_2, and mixtures or compounds formed from said oxides; and preferably a covalent oxide from the group Sn, Zn, In (col. 5, l. 50-60). The formation of a ternary compound containing zinc, tin and oxide, although not explicitly recited by Cillessen et al, is indeed a simple compound formed from ZnO and SnO_2. The claim would have been obvious because

one of ordinary skill has good reason to pursue the known options within his or her technical grasp. If this leads to the anticipated success, it is likely the product not of innovation but of ordinary skill and common sense.

On claims 7, 32, 35 and 54: source, drain and gate electrodes are fabricated so as to be at least partially transparent (see abstract).

On claims 8-9 and 33-34: the limitations of claims 8 and 9 are met by virtue of the finite dissociation constant of a ternary zinc-tin-oxide compound. For the finiteness of said dissociation constant the examiner has previously taken official notice. Accordingly, the finite dissociation constant of, for instance, Zn2SnO4 is considered Prior Art admitted by Applicant (cf. MPEP 2144.03[R-1]).

On claim 12 and 37: the source and drain electrodes are formed from an indium-tin-oxide material (col. 7, l. 41 – col. 8, l. 39, especially col. 8, l. 29). The manner of fabrication is without patentable weight, being a product-by-process limitation; however, the manner of fabrication does include patterning the source/drain electrodes (loc.cit.), while the final result is their physical separation, without which the thin film transistor would not be operative (Figure 4).

On claim 55: the semiconductor device further comprises means for providing a dielectric 6 (abstract and col. 4, l. 27-58) (interpreted in light of the specification as dielectric medium 90) disposed between and physically separating the gate electrode from the means for providing a channel.

On claim 26: the limitation of this claim is simply inherent to all field effect transistors, including the thin film transistors. See also col. 6, l. 46+.

7. ***Claims 6, 11, 31 and 36*** rejected under 35 U.S.C. 103(a) as being unpatentable over Cillessen et al in view of Carcia et al (2004/0127038 A1) (cited previously). Although Cillessen et al do not necessarily teach the further limitations of these claims, it would have been obvious to use RF, in particular magnetron, sputtering in view of Carcia et al (see [0010]), inherently yielding a substantially amorphous material. The claim would have been obvious because the technique (RF sputtering of covalent oxides of non-transition metals) was part of the ordinary capabilities of a person of ordinary skill in view of the technique for improvement in a very similar situation.

8. ***Claims 14 and 38*** are rejected under 35 U.S.C. 103(a) as being unpatentable over Carcia et al in view of Krivokapic et al (6,100,558) (cited previously).

As detailed above, Carcia et al anticipate claims 55 and 60.

Carcia et al do not necessarily teach the limitation that said dielectric material is an aluminum-titanium oxide material. *However, it would have been obvious to include said limitation as witnessed, for instance, by Krivokapic et al,* teaching a combination of Al_2O_3 and TiO_2 for the gate dielectric layer the purpose of increasing the dielectric constant of the gate oxide (Figure 19 and column 8, lines 3-26) so as to overcome adverse effects of small defects or contamination of the gate oxide material (see "Background of the Invention", col. 1). *Motivation* to include the teaching by Krivokapic et al in the invention by Carcia et al derives from the consequent reduction in defective operation.

END OF GROUNDS OF REJECTION.

(10) Response to Argument

a. Appellant alleges on page 13 of the Appeal Brief that Carcia is not prior art as "only subject matter within Carcia that was previously disclosed in the Carcia provisional is available as prior art against the present application". Examiner had previously pointed out that appellant's own provisional does not disclose the more specific compounds, in particular, does not disclose Zn_2SnO_4 as recited in claims 4, 19, 48, 60 and 64, and claims dependent thereon; nor does said provisional by appellant disclose the ternary compound delineation recited in claim 50. Therefore, the effective file date of the instant application for the currently claimed and appealed subject matter is defined by the file date of the utility application by appellants, which is January 23, 2004. The file date of Carcia et al is September 24, 2003, which is before appellants' utility application's fiel date of January 23, 2004. Therefore, Carcia et al is prior art for the disclosure of the ternary compounds in their specific claimed forms based on the utility application and because appellant's provisional suffers from the same lack of disclosure as the provisional of Carcia et al. That "examiner has not examined the contents of the Carcia provisional" (page 13) is disproved by the text of the Non-Final Office action mailed 11/27/07, page 30, item 8.

b. Appellants allege further (page 14) that Carcia, although teaching combinations of binary compound oxides, do not teach or suggest the use of ternary compounds. Examiner disagrees, because a combination of two binary

oxides is a ternary compound oxide and hence is implied by “and combinations thereof”.

c. Appellants point to “surprising” and “unexpected” results on mobility of the inventive ternary compounds and materials, referring to page 2 of the specification (see page 15 of the Appeal Brief). It should be pointed out that a discussion on surprising and unexpected results is not found on page 2, but instead is found on pages 3-4, and is accompanied neither by any data, nor by any comparison with previously published data. Nor is there any Declaration on file providing the required evidence of unexpected results. Furthermore, for a channel material in a transistor it is not decisive what its mobility is in the absence of gate action, but rather what its characteristics are in the OFF state (low mobility) and in the ON state (high mobility). Appellant’s provisional contains some experimental data on mobility and modeling, however is completely devoid of any disclosure on ternary compounds, let alone on their mobility characteristics, and thus at best supports mobility data of appellants’ “materials” (rather than “compounds”) for which a rejection based on prior art does not necessarily have to rely on Carcia et al. In summary on appellants’ argument of “surprising and unexpected results”, appellant has not presented any persuasive argument that results for mobility of the inventive ternary channel compounds were surprising or unexpected in light of the prior art findings for mobility of said ternary compounds. That it has long been known in the prior art that the zinc-tin-oxide *compound* Zn_2SnO_4 has a mobility far greater than the mobilities provided

by appellants in their provisional for zinc-tin-oxide *material* (their Figure 5 and discussion) is witnessed by Young et al, made of record by examiner.

d. Appellant's next argument is that "and combinations thereof" would not have been interpreted to mean "ternary zinc-tin oxide" (page 15). However, ternary zinc-tin oxide is the result when combining ZnO with SnO_2. Appellant further argues that Zn_2SnO_4 is not a simple combination because two ZnO molecules rather than one are required for the chemical reaction (sic) (page 15). However, valence, as anyone with high-school chemistry knows, imposes severe constraints on the additional degree of freedom from which to perform a selection, allowing only two ternary compounds, i.e., $ZnSnO_3$ (no longer specifically claimed) and Zn_2SnO_4. Therefore, said argument fails to persuade.

e. Appellant's argument on claim 50 does not convince because Zn_2SnO_4 trivially meets the claimed range (take j= 2/3), which thus is seen to be much broader and to encompass the previous independent claims on composition of the inventive ternary channel compound. That Carcia et al, by admission of appellant, is completely silent with respect to the possibility of "non-stoichiometric compounds" is noted for the record, but is self-contradictory: a compound is always stoichiometric and specifically outrules complete, i.e., continuous, coverage of the range as claimed. Both Zn_2SnO_4 and $ZnSnO_3$ fall in said claimed range (for the latter take j= ½).

f. Appellant's argument on claim 19 only comprises all of the arguments mentioned above, and hence fails to persuade for the same reasons.

g. Appellants' arguments on claim 12, on claims 14 and 38, on claims 15 and 39, and on claim 64 entirely rely, respectively, only repeat the arguments discussed above with regard to the rejection of the previous independent claims, and hence fail to persuade for the same reasons.

h. Appellants' first argument (pages 22-23) on the rejection under 35 U.S.C. 103(a) over Cillessen et al misrepresents all combinations as equally obvious. On the contrary: the simplest and most easily carried out combinations are those involving only two binary compounds. In this light the listing (pages 24-30) of all possible combinations suggests a serious overestimate of the number of combinations of the simplest, and hence most obvious category of combined compounds. On the contrary, only 28 pairings of metal elements are possible among the eight listed oxides of which Cillessen et al suggest compound combinations (col. 5, l. 30-50), and, as explained before, valence imposes a very severe limitation on the compound that can possibly be formed, given the three atomic elements from which the compound is made. For these reasons, the listing of combinations by Appellants (pages 24-30), and even a listing of ternary compounds regardless consideration of valence is very much more extensive than the true number of obvious combinations leading to ternary compounds.

i. Appellants argue (pages 32-33) also for Cillessen et al that their inventive ternary compound is not a known option and that the evidence contradicts the assertion that it is, and that appellants found "unexpected results". However, no evidence of unexpected results on mobility of Zn_2SnO_4 can be found anywhere in

the application. Furthermore, the compound Zn_2SnO_4 (i.e., zinc stannate) has long been well known for its good mobility, with reference to the article by Young et al, which quantifies mobility of zinc stannate with detailed experimental data. Their work was prompted by the prospect of a useful semiconductor material. Clearly, then, mobilities up to 26 $cm^2/(V.s)$ far in excess over applicants' provisional data (Figure 5 in the provisional application) (only up to a few $cm^2/(V.s)$) were not at all surprising at the time of filing, given the prior art of record.

j. The remainder of the arguments mirror those in the rejection over Carcia et al and are not persuasive for the same reasons as provided above: specifically, again the more broadly claimed composition as recited in claim 50 simply includes Zn_2SnO_4 (trivially: select j=2/3).

In conclusion, for all of the above reasons, examiner believes the grounds of rejection in the appealed Office action to have been proper, and that the rejections have to be sustained.

(11) Related Proceeding(s) Appendix

No decision rendered by a court or the Board is identified by the examiner in the Related Appeals and Interferences section of this examiner's answer.

For the above reasons, it is believed that the rejections should be sustained.

Respectfully submitted,

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a/s: Enc: PTO-892 & Interview Summary

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